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Maruyama et al.

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(54) **ELECTRIC FLUID PUMP**

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(22) Filed: **Jan. 8, 2014**

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(30) **Foreign Application Priority Data**

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F04D 29/04 (2006.01)
F04D 25/06 (2006.01)
F04D 13/06 (2006.01)
F04D 29/043 (2006.01)

(52) **U.S. Cl.**
CPC ***F04D 25/0606*** (2013.01); ***F04D 13/0606*** (2013.01); ***F04D 13/0626*** (2013.01); ***F04D 13/0633*** (2013.01); ***F04D 29/043*** (2013.01)

(58) **Field of Classification Search**
CPC .. F04D 13/026; F04D 13/06; F04D 13/0606; F04D 13/0633; F04D 29/04; F04D 29/043; F04D 29/044; F04D 29/0646
USPC 417/423.11, 423.12
See application file for complete search history.

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(57) **ABSTRACT**

An electric fluid pump includes: a case including a recess portion into which a fluid flows; a rotor arranged in the recess portion; an axial member supporting the rotor; and a flange member insert-molded with the case and the axial member, secured to an end portion of the axial member, and buried in a bottom wall portion of the recess portion, wherein the flange member includes: a first flange portion; a reduced portion closer to an inner surface of the bottom wall portion than the first flange portion, and smaller than the first flange portion in a radial direction; and a second flange portion closer to the inner surface than the reduced portion, larger than the first flange portion in the radial direction, and partially exposed from the inner surface, and the inner surface is flat.

4 Claims, 8 Drawing Sheets

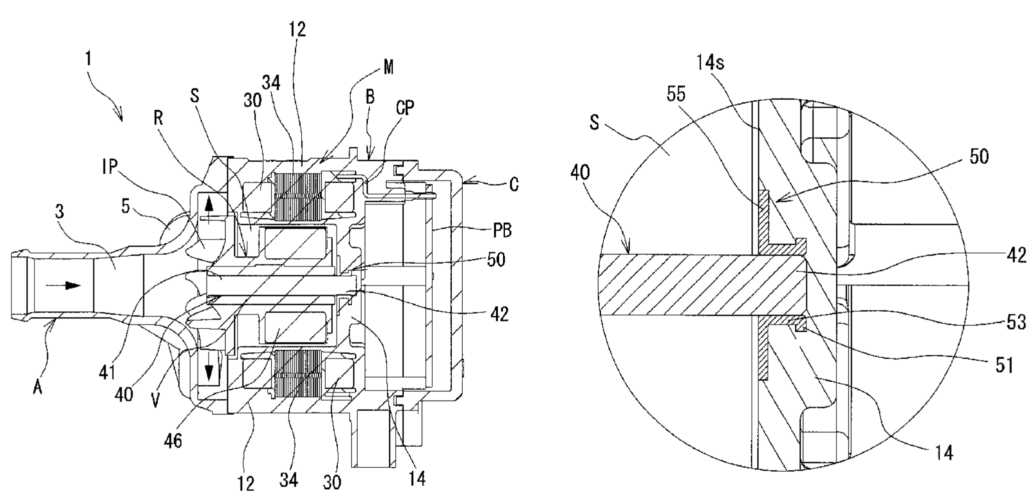


FIG. 1

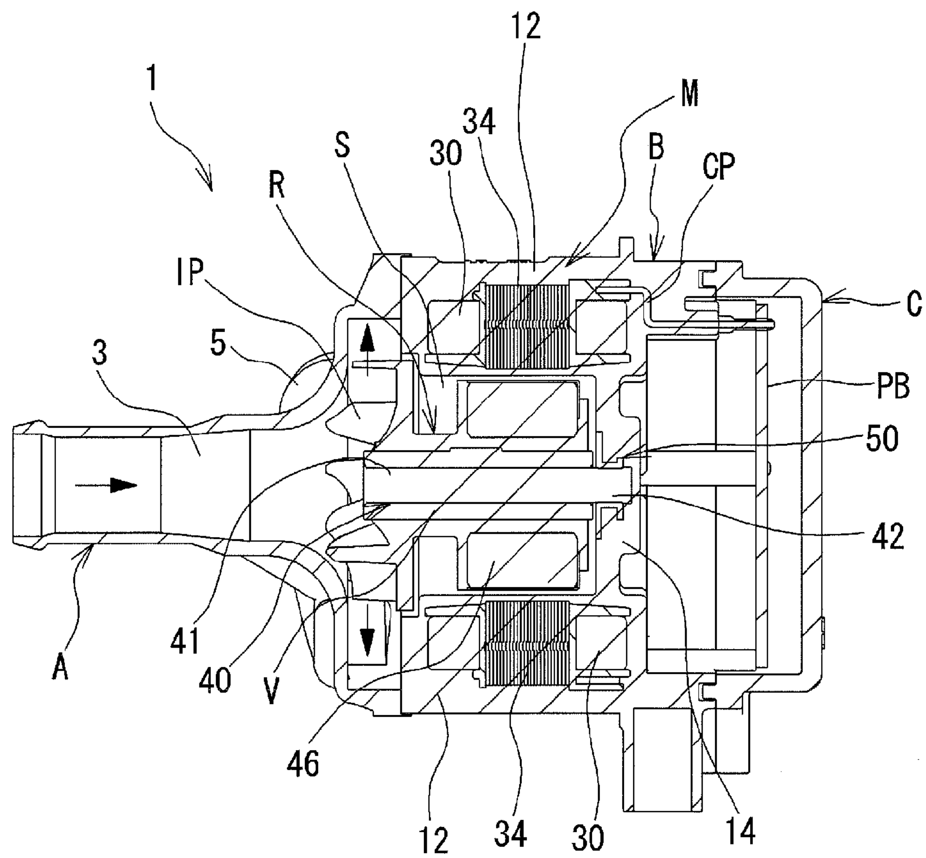


FIG. 2

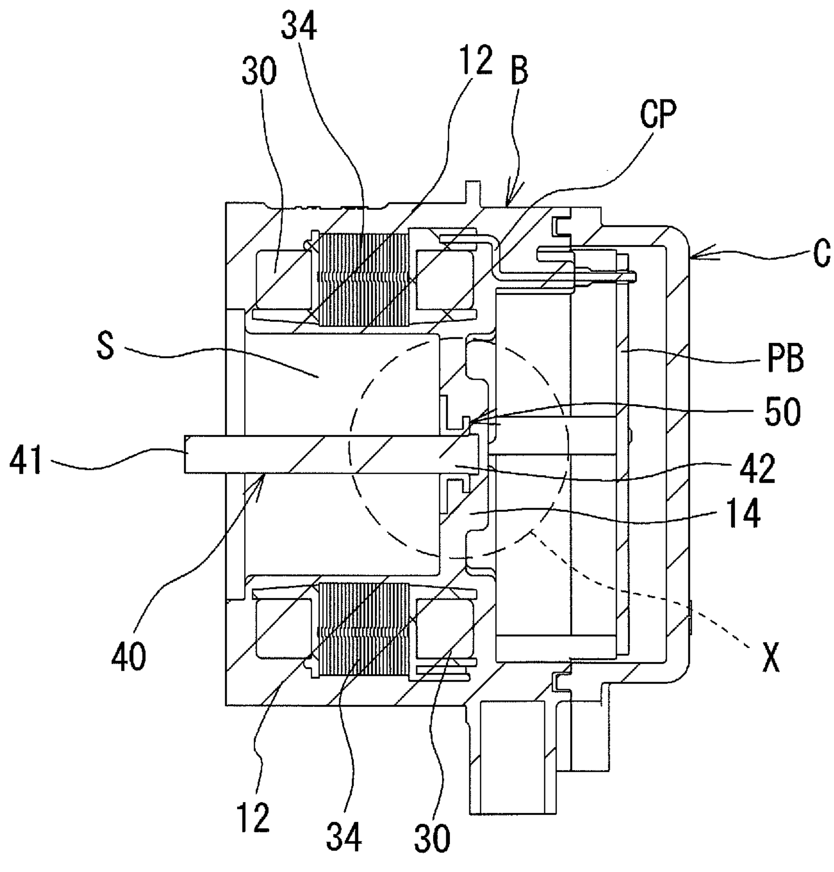


FIG. 3A

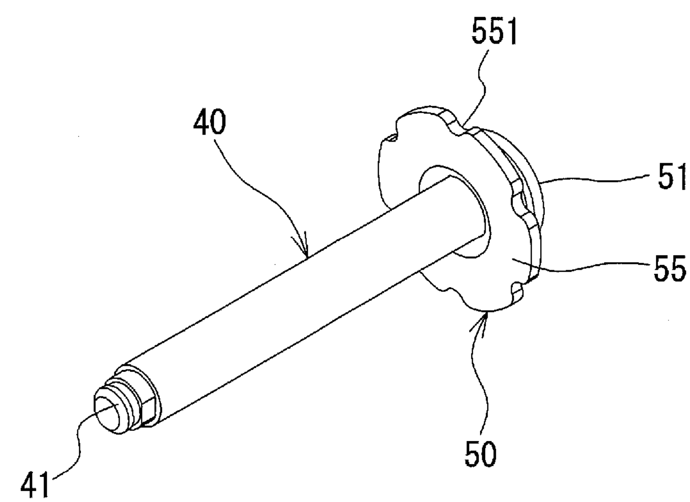


FIG. 3B

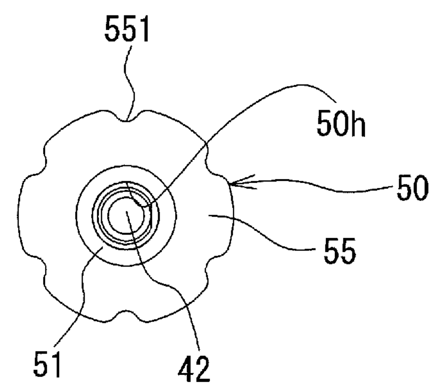


FIG. 3C

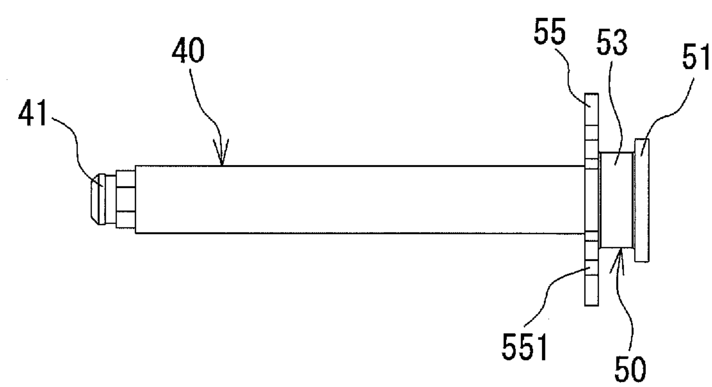


FIG. 4

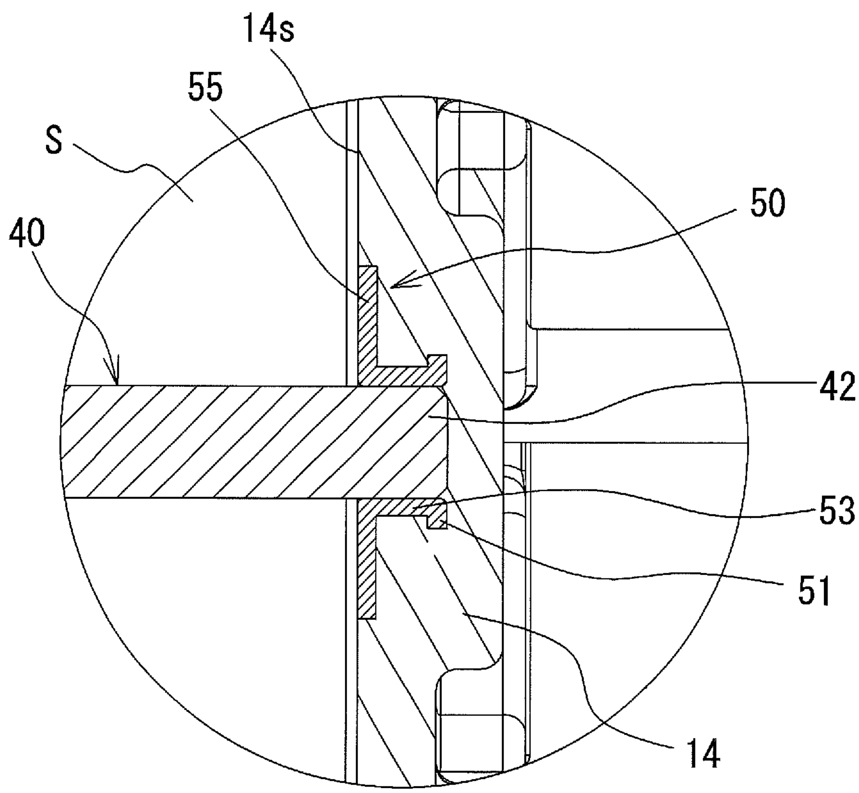


FIG. 5

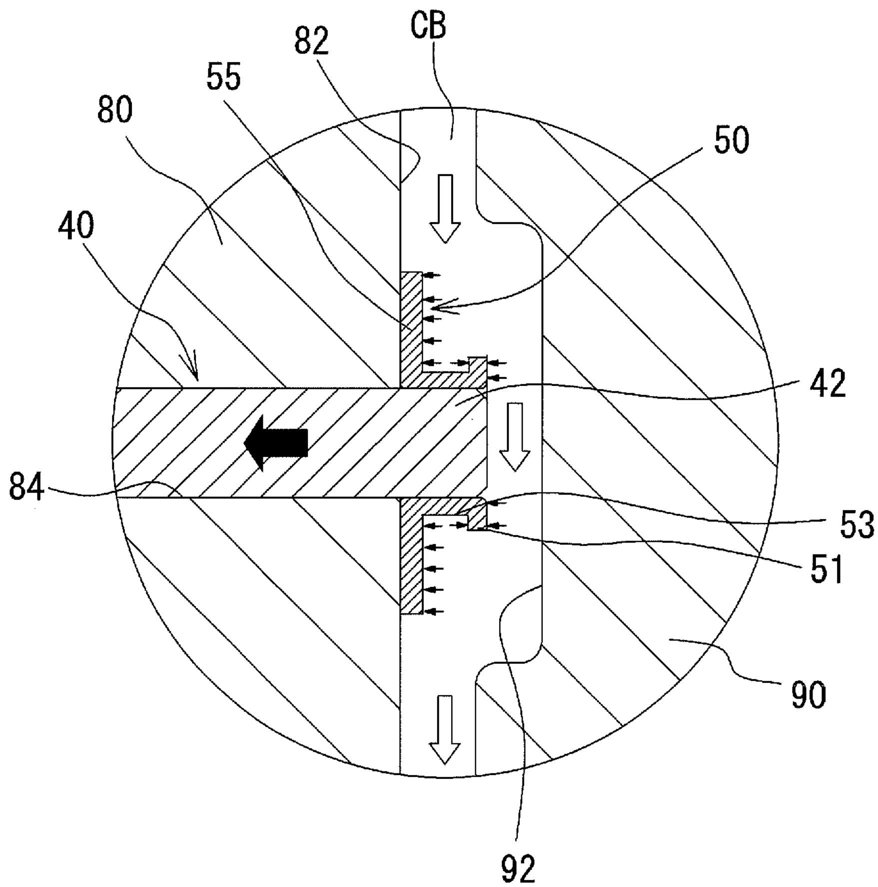


FIG. 6A

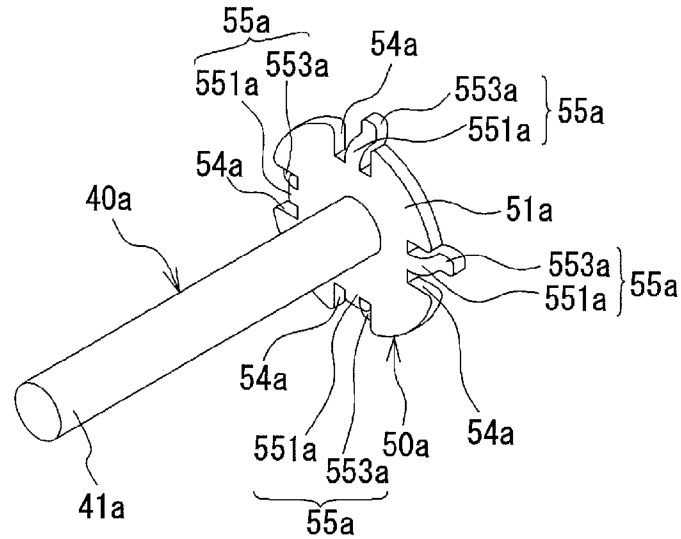


FIG. 6B

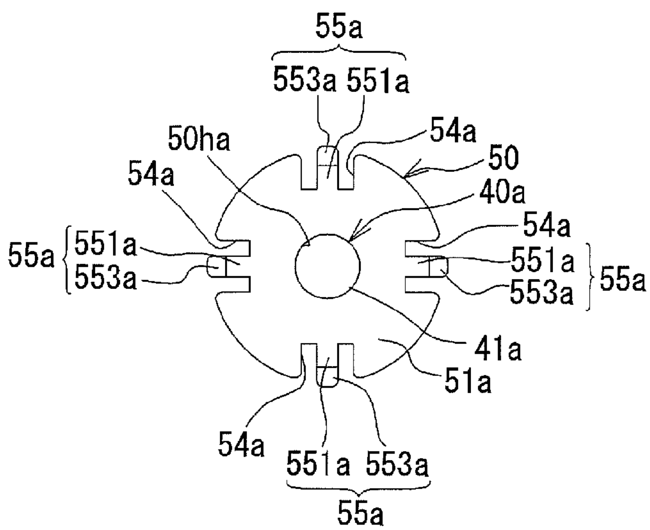


FIG. 6C

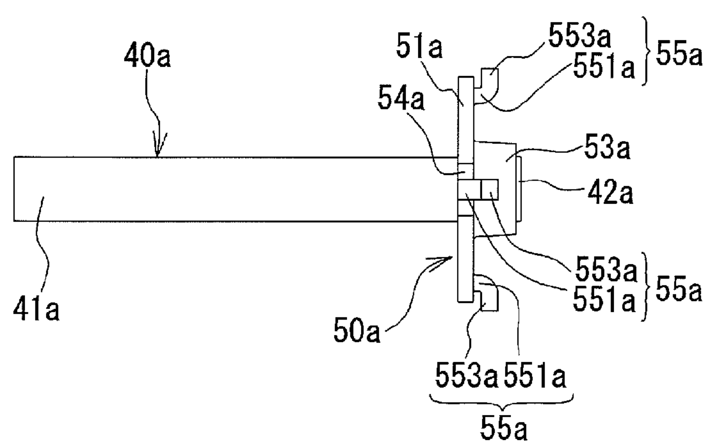


FIG. 7

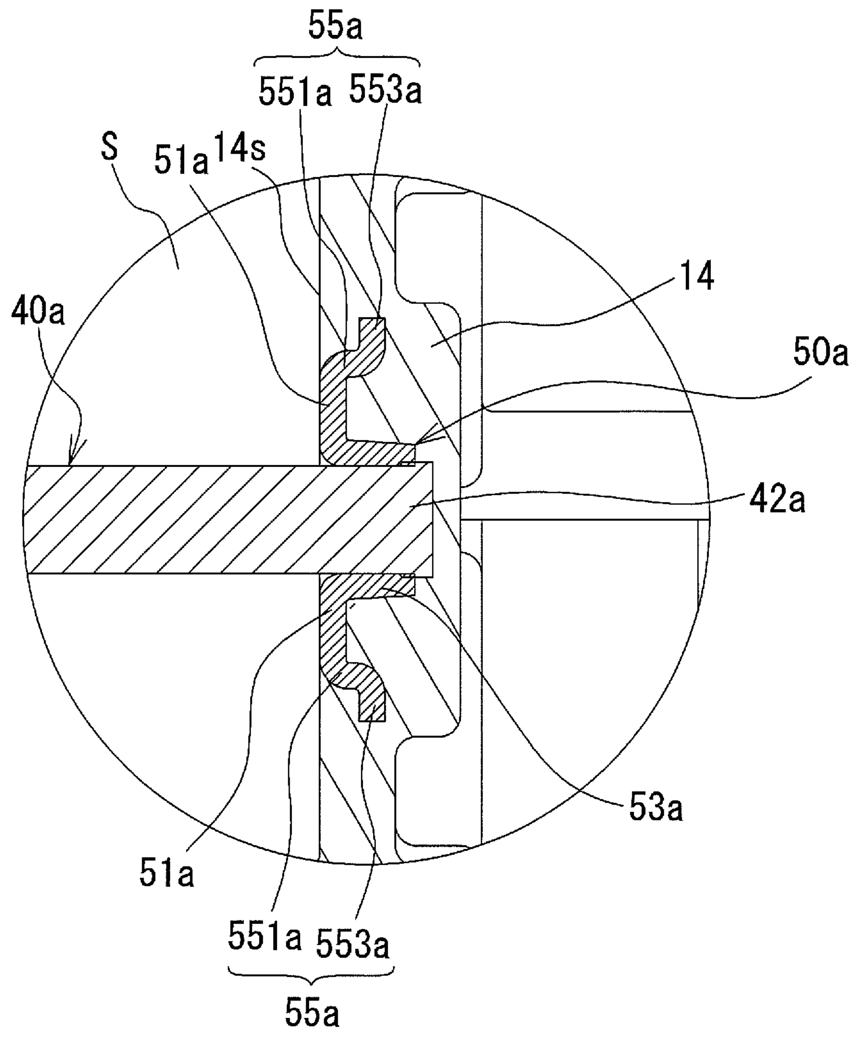
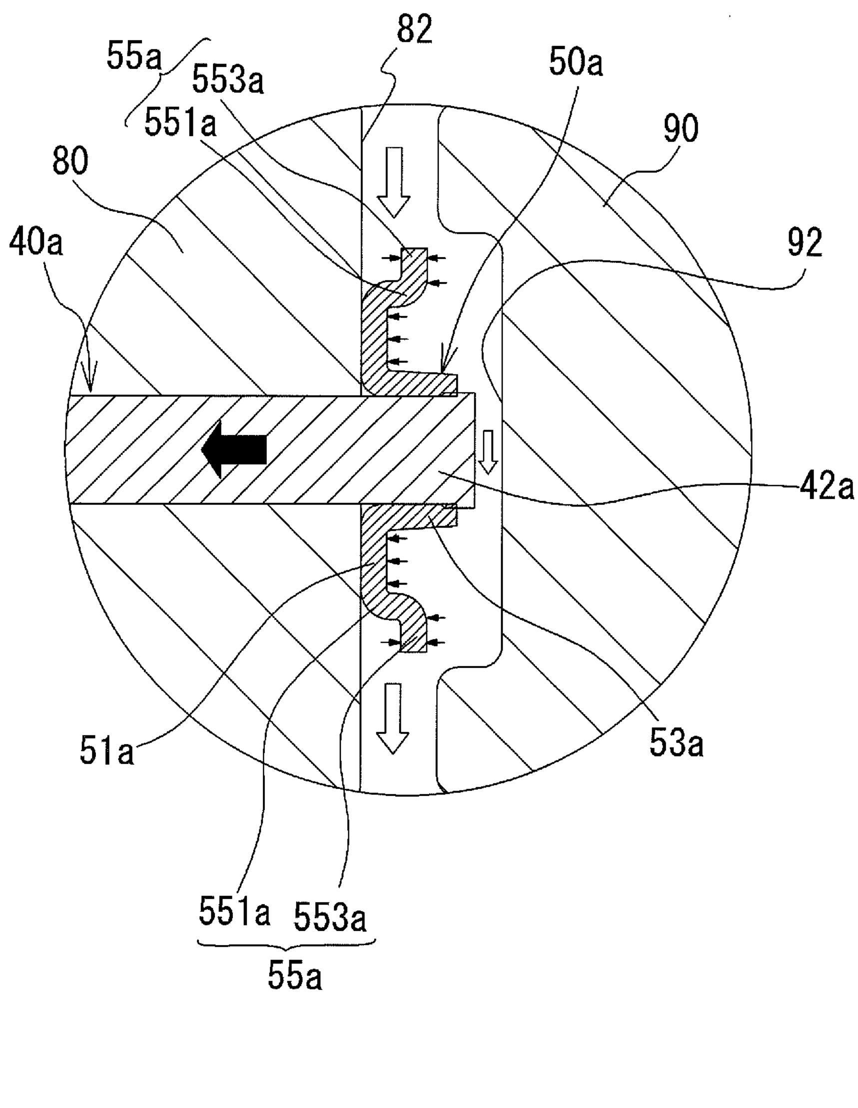


FIG. 8



ELECTRIC FLUID PUMP

CROSS-REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority of the prior Japanese Patent Application No. 2013-036414, filed on Feb. 26, 2013, the entire contents of which are incorporated herein by reference.

BACKGROUND

(i) Technical Field

The present invention relates to an electric fluid pump.

(ii) Related Art

Japanese Patent Application Publication No. 2010-144693 discloses a technique for positioning an axial member by pushing the axial member against a metal mold when the axial member which supports a rotor is insert-molded with a case which has a recess portion housing the rotor.

However, as illustrated in FIGS. 1 and 3 of Japanese Patent Application Publication No. 2010-144693, an inner surface 22 of the recess portion housing the rotor is depressed to increase a capacity of the recess portion. Therefore, resistance of the fluid which has flowed into the recess portion might degrade rotation efficiency of the rotor. Further, in FIG. 6 of Japanese Patent Application Publication No. 2010-144693, depending on the flowing of the resin in insert molding, the resin preferentially flows to an inner side end surface 12b, so that the axial member might sink in a bottom wall portion of the recess portion. This might not ensure positional accuracy of the axial member.

SUMMARY

According to an aspect of the present invention, there is provided an electric fluid pump including: a case including a recess portion into which a fluid flows; a rotor arranged in the recess portion; an axial member supporting the rotor; and a flange member insert-molded with the case and the axial member, secured to an end portion of the axial member, and buried in a bottom wall portion of the recess portion, wherein the flange member includes: a first flange portion; a reduced portion closer to an inner surface of the bottom wall portion than the first flange portion, and smaller than the first flange portion in a radial direction; and a second flange portion closer to the inner surface than the reduced portion, larger than the first flange portion in the radial direction, and partially exposed from the inner surface, and the inner surface is flat.

According to another aspect of the present invention, there is provided an electric fluid pump including: a case including a recess portion into which a fluid flows; a rotor arranged in the recess portion; an axial member supporting the rotor; and a flange member insert-molded with the case and the axial member, secured to an end portion of the axial member, and buried in a bottom wall portion of the recess portion, wherein the flange member includes: a flat plate portion partially exposed from an inner surface of the bottom wall portion; a groove portion formed at an outer circumferential portion of the flat plate portion; and a projection portion projecting from the groove portion so as to be distant from the inner surface, and the inner surface is flat.

According to another aspect of the present invention, there is provided an electric fluid pump including: a case including a recess portion into which a fluid flows; a rotor arranged in the recess portion; and an axial member including an end portion buried in a bottom wall portion of the recess portion, supporting the rotor, and being insert-molded with the case, wherein the end portion includes: a first flange portion; a reduced portion closer to an inner surface of the bottom wall portion than the first flange portion, and smaller than the first flange portion in a radial direction; and a second flange portion closer to the inner surface than the reduced portion, larger than the first flange portion in the radial direction, and partially exposed from the inner surface, and the inner surface is flat.

According to another aspect of the present invention, there is provided an electric fluid pump including: a case including a recess portion into which a fluid flows; a rotor arranged in the recess portion; and an axial member including an end portion buried in a bottom wall portion of the recess portion, supporting the rotor, and being insert-molded with the case, wherein the end portion includes: a flat plate portion partially exposed from an inner surface of the bottom wall portion; a groove portion formed at an outer circumferential portion of the flat plate portion; and a projection portion projecting from the groove portion to be distant away from the inner surface, and the inner surface is flat.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of an electric fluid pump according to the present embodiment;

FIG. **2** is a view of the electric fluid pump from which a part of a case and a rotor are removed;

FIGS. **3**A to **3**C are explanatory views of the axial member and a flange member;

FIG. **4** is an enlarged view around the flange member surrounded by a circle X of FIG. **2**;

FIG. **5** is an explanatory view of insert molding of the case;

FIGS. **6**A to **6**C are explanatory views of an axial member and a flange member according to a variation embodiment;

FIG. **7** is an enlarged view around the flange member according to the variation embodiment; and

FIG. **8** is an explanatory view of insert molding of the case with the axial member and the flange member according to the variation embodiment.

DETAILED DESCRIPTION

FIG. **1** is a sectional view of an electric fluid pump **1** according to the present embodiment. The electric fluid pump **1** is equipped with three cases A, B, and C. The case A is secured to the case B. The case B is secured to the case C. A motor M is arranged in the case B with parts buried therein. The motor M includes a rotor R, an iron core **30**, and plural coils **34** wound around the iron core **30**. A printed circuit board PB electrically connected to the coils **34** is arranged in the case C. The coils **34** and the printed circuit board PB are electrically connected via pins CP. The case A is formed with an inlet **3** for introducing the fluid and an outlet **5** for discharging the fluid. The case B is formed at its inside with a recess portion S in which the rotor R is arranged.

The case B includes a side wall portion **12** defining the recess portion S, and a bottom wall portion **14**. The case B is made of a synthetic resin. The case B is insert-molded with the iron core **30**, an axial member **40** supporting the rotor R for rotation, and a flange member **50** secured to an end portion **42** of the axial member **40**. The iron core **30**, the coils **34**, and the pins CP are buried in the side wall portion **12**. The end portion **42** of the axial member **40** and the flange member **50** are buried in the bottom wall portion **14**. The axial member **40** is made of metal, and the flange member **50** is made of a synthetic resin. However, both may be made of metal or a synthetic resin.

The rotor R holds plural permanent magnets **46** which face the side wall portion **12** of the case B. An end side of the rotor R is provided with an impeller IP for introducing the fluid from the inlet **3** and discharging the fluid through the outlet **5**.

The impeller IP is provided at an end portion **41** side of the axial member **40**. A bearing V intervenes between the rotor R and the axial member **40**. The bearing V is secured to the rotor R. The energization of the coils **34** excites the iron core **30** to have predetermined polarities, so that the rotor R is rotated by the magnetic force generated between the iron core **30** and the permanent magnets **46**. Therefore, the impeller IP rotates.

FIG. **2** is a view of the electric fluid pump **1** from which the case A and the rotor R are removed. In this way, the rotor R rotates in the recess portion S. Herein, as illustrated in FIG. **1**, the fluid introduced from the inlet **3** flows into the recess portion S through a clearance between the impeller IP and an opening portion of the recess portion S. Thus, the rotor R rotates in the fluid which has flowed into the recess portion S.

FIGS. **3**A to **3**C are explanatory views of the axial member **40** and the flange member **50**. The flange member **50** is secured to the end portion **42**.

Specifically, the end portion **42** of the axial member **40** is press-fitted into a hole **50***h* formed in the flange member **50**. However, the present invention is not limited to this configuration. For example, both members may be secured by caulking. The flange member **50** includes a flange portion **51**, a reduced portion **53**, and a flange portion **55** in the order from the end portion **42** to the end portion **41** side. The reduced portion **53** is smaller than the flange portion **51** in the radial direction. The flange portion **55** is larger than each of the flange portion **51** and the reduced portion **53** in the radial direction.

FIG. **4** is an enlarged view around the flange member **50** surrounded by a circle X of FIG. **2**. The flange portion **51** is close to an inner surface **14***s* of the bottom wall portion **14**. The reduced portion **53** is closer to the inner surface **14***s* than the flange portion **51**. The flange portion **55** is closer to the inner surface **14***s* than the reduced portion **53**. Additionally, the flange portion **55** is partially exposed from the inner surface **14***s*, and comes into slidable contact with the end surface of the rotor R.

As illustrated in FIG. **4**, the reduced portion **53** is formed between the flange portions **51** and **55**, and is smaller than each of them. Therefore, even if a large tensile force is applied to the end portion **41** side of the axial member **40**, the axial member **40** and the flange member **50** are prevented from being removed from the bottom wall portion **14** by the resin which is filled around the reduced portion **53** between the flange portions **51** and **55**.

Also, as illustrated in FIGS. **3**A to **3**C, the outer circumferential portion of the flange portion **55** is provided with plural groove portions **551**. The plural groove portions **551** are provided at even angular intervals around the center of the axial member **40**. Thus, the flange portion **55** has a non-circular shape when viewed in the axial direction. Therefore, the flange portion **55** is prevented from being rotated in the circumferential direction by the resin filled around the groove portions **551**. Additionally, the flange portion **55** may have another shape as long as it has a non-circular shape.

FIG. **5** is an explanatory view of the insert molding of the case B. The axial member **40** press-fitted into the flange member **50** beforehand is inserted into a hole **84** of a metal mold **80**, and the flange portion **55** of the flange member **50** is brought into contact with a surface **82** of the metal mold **80**. Next, the resin is filled into a cavity CB defined between the surface **82** of the metal mold **80** and a surface **92** of a metal mold **90** facing the metal mold **80**.

The resin is filled into the cavity CB, so that the resin flows between the flange portions **51** and **55**. The force of the resin is applied to the flange portion **55** such that the flange portion **55** is pushed against the surface **82** of the metal mold **80**. The force is applied to the flange portion **51** such that the flange portion **55** moves away from the surface **82**. Here, the flange portion **55** is larger than the flange portion **51** in the radial direction, and also the area of the flange portion **55** is greater than that of the flange portion **51**. Therefore, the force of the resin which pushes the flange portion **55** toward the metal mold **80** is greater than that of the resin which pushes the flange portion **51** to move away from the metal mold **80**.

Thus, the force of the flowing resin maintains a state where the flange portion **55** of the flange member **50** is pushed against the surface **82** of the metal mold **80**. Therefore, in the state where the flange member **50** and the axial member **40** are positioned with respect to the metal mold **80**, the resin is hardened to form the case B. Accordingly, the positional accuracy of the axial member **40** is ensured.

Further, since the surface **82** is flat, the inner surface **14***s* of the bottom wall portion **14** of the case B also is formed into a flat shape. This suppresses an increase in the capacity of the recess portion S after formed. This also suppresses an amount of the fluid which flows into the recess portion S, thereby suppressing the rotation efficiency of the rotor R from deteriorating.

Also, the flange member **50** is formed by pressing. Thus, the manufacturing cost of the electric fluid pump **1** is reduced.

Next, a description will be given of an axial member **40***a* and a flange member **50***a* according to a variation embodiment. FIGS. **6**A to **6**C are explanatory views of the axial member **40***a* and the flange member **50***a* according to the variation embodiment. FIGS. **6**A to **6**C respectively correspond to FIGS. **3**A to **3**C. The flange member **50***a* is secured to an end portion **42***a*. Specifically, the end portion **42***a* of the axial member **40***a* is press-fitted into a hole **50***ha* formed in the flange member **50***a*. However, the present invention is not limited to this configuration. For example, both members may be secured by caulking. The flange member **50***a* includes a pipe portion **53***a* and a flat plate portion **51***a* in the order from the end portion **42***a* to an end portion **41***a* side. The pipe portion **53***a* is press-fitted onto the end portion **42***a*. The outer diameter of the flat plate portion **51***a* is greater than that of the pipe portion **53***a*. Also, the pipe portion **53***a* is thicker than the flat plate portion **51***a* in the axial direction.

The outer circumferential portion of the flat plate portion **51***a* is provided with plural groove portions **54***a*. The groove portion **54***a* is formed with a projection portion **55***a* which projects radially outward. The four groove portions **54***a* are provided at even angular intervals around the center of the axial member **40***a*. The projection portions **55***a* also have the same configuration. The projection portion **55***a* projects to the pipe portion **53***a* side from the flat plate portion **51***a*. Specifically, the projection portion **55***a* includes: a root portion **551***a* which projects from a bottom surface of the groove portion **54***a* and is curved; and an end portion **553***a* which projects from the root portion **551***a* in the direction perpendicular to the axial member **40***a*. The root portion **551***a* is curved to the pipe portion **53***a* side from the flat plate portion **51***a*. As illustrated in FIG. **6**C, the end portion **553***a* extends more than the outer circumferential portion of the flat plate portion **51***a* in the radial outward direction.

FIG. **7** is a partially enlarged view of an electric fluid pump equipped with the axial member **40***a* and the flange member **50***a*. FIG. **7** corresponds to FIG. **4**. The end portions **553***a* are distant from the inner surface **14***s* and are buried in the bottom wall portion **14**. Therefore, even if a large tensile force is applied to the end portion **41***a* side of the axial member **40***a*, the axial member **40***a* and the flange member **50***a* are prevented from being removed from the bottom wall portion **14** by the resin which is filled over the end portions **553***a*.

Also, as illustrated in FIGS. **6**A to **6**C, the outer circumferential portion of the flat plate portion **51***a* is provided with the plural groove portions **54***a* to have a non-circular shape. Therefore, the flat plate portion **51***a* is prevented from being rotated in the circumferential direction by the resin filled within the groove portions **54***a*.

FIG. **8** is an explanatory view of the insert molding of the case by use of the axial member **40***a* and the flange member **50***a*. FIG. **8** corresponds to FIG. **5**. The axial member **40***a* press-fitted into the flange member **50***a* beforehand is inserted into the hole **84** of the metal mold **80**, and the flat plate portion **51***a* of the flange member **50***a* is brought into contact with the surface **82** of the metal mold **80**. Next, the resin is filled into the cavity CB defined between the surface **82** of the metal mold **80** and the surface **92** of the metal mold **90** facing the metal mold **80**.

The resin is filled into the cavity CB, so that the resin flows around the projection portions **55***a* at first. The resin flows not only to the upper side of the end portions **553***a* but also to the lower side thereof. Also, the resin flows to the lower side of the flat plate portion **51***a*. Therefore, the force of the resin is applied to the flat plate portion **51***a* such that the flat plate portion **51***a* is pushed against the surface **82** of the metal mold **80**. The force is applied to the upper surfaces of the end portions **553***a* such that the end portions **553***a* move away from the surface **82**. Here, the area of the lower surface of the flat plate portion **51***a* is greater than that of the upper surfaces of the end portions **553***a*. Therefore, the force of the resin which pushes the flange member **50***a* toward the metal mold **80** is greater than that of the resin which pushes the flange member **50***a* to move away from the metal mold **80**.

Thus, the force of the flowing resin maintains a state where the flat plate portion **51***a* of the flange member **50***a* is pushed against the surface **82** of the metal mold **80**. Therefore, in the state where the flange member **50***a* and the axial member **40***a* are positioned with respect to the metal mold **80**, the resin is hardened to form the case. Accordingly, the positional accuracy of the axial member **40***a* is ensured.

Also, the flange member **50***a* is formed by pressing. Thus, the manufacturing cost of the electric fluid pump is reduced.

While the exemplary embodiments of the present invention have been illustrated in detail, the present invention is not limited to the above-mentioned embodiments, and other embodiments, variations and modifications may be made without departing from the scope of the present invention.

The flange member may be formed by cutting. Further, an axial member which is integrally formed with an flange member may be employed.

What is claimed is:

1. An electric fluid pump comprising:

a case including a recess portion into which a fluid flows;

a rotor arranged in the recess portion;

an axial member supporting the rotor, the rotor being positioned radially outward of the axial member, the axial member being a shaft that is unrotatably fixed to the case; and

a flange member insert-molded with the case and the axial member, the flange member being secured to an end portion of the axial member, the flange member being buried in a blind hole formed in a bottom wall portion of the recess portion, the flange member including:

a first flange portion;

a reduced portion disposed closer to a flat inner surface of the bottom wall portion than the first flange portion, the reduced portion being smaller than the first flange portion in a radial direction; and

a second flange portion disposed closer to the flat inner surface than the reduced portion, the second flange portion being larger than the first flange portion in the radial direction, and the second flange portion being partially exposed from the flat inner surface.

2. The electric fluid pump of claim **1**, wherein the flange member is made of metal and formed by pressing.

3. The electric fluid pump of claim **1**, wherein the second flange portion has a non-circular shape when viewed in an axial direction of the axial member.

4. An electric fluid pump comprising:

a case including a recess portion into which a fluid flows;

a rotor arranged in the recess portion; and

a shaft unrotatably fixed to the case, the shaft including an end portion buried in a blind hole formed in a bottom wall portion of the recess portion, the end portion supporting the rotor, the end portion being insert-molded with the case, the end portion including:

a first flange portion;

a reduced portion disposed closer to a flat inner surface of the bottom wall portion than the first flange portion, the reduced portion being smaller than the first flange portion in a radial direction; and

a second flange portion disposed closer to the flat inner surface than the reduced portion, the second flange portion being larger than the first flange portion in the radial direction, the second flange portion being partially exposed from the flat inner surface, wherein

the rotor is positioned radially outward of the shaft.

* * * * *